



IBM SmartCloud Desktop Infrastructure: Citrix XenDesktop on IBM Flex System

IBM Redbooks Solution Guide

The IBM® SmartCloud™ Desktop Infrastructure offers robust, cost-effective, and manageable virtual desktop solutions for a wide range of clients, user types, and industry segments. These solutions can help to increase business flexibility and staff productivity, reduce IT complexity, and simplify security and compliance. Based on a reference architecture approach, this infrastructure supports various hardware, software, and hypervisor platforms. Figure 1 illustrates the SmartCloud Desktop Infrastructure offering.



Figure 1. The IBM SmartCloud Desktop Infrastructure offering

The SmartCloud Desktop Infrastructure solution with Citrix XenDesktop running on IBM Flex System™ offers tailored solutions for every business, from the affordable all-in-one Citrix VDI-in-a-Box for simple IT organizations to the enterprise-wide Citrix XenDesktop. XenDesktop is a comprehensive desktop virtualization solution with multiple delivery models that is optimized for flexibility and cost efficiency.

Did you know?

The hosted virtual desktop (HVD) approach is the most common form of implementing a virtualized user desktop environment. With HVDs, all applications and data that the user interacts with are stored centrally and securely in the data center. These applications never leave the data center boundaries. This setup makes management and administration much easier and gives users access to data and applications from anywhere and at anytime.

Business value

Several key factors drive virtual desktops in today's business climate:

- Data security and compliance concerns
- Complexity and costs of managing existing desktop environments
- An increasingly mobile workforce
- The changing ownership of end-point devices with bring-your-own-device (BYOD) programs
- The need for rapid recovery from theft, failure, and disasters

SmartCloud Desktop Infrastructure offers the following advantages:

- Simplifies desktop administration, support, and management
- Enhances security and compliance management
- Improves availability and reliability
- Enables users to work anytime, anywhere quickly and easily regardless of location or device
- Better supports growth initiatives for mobility and flexible work locations

Solution overview

IBM SmartCloud Desktop Infrastructure solution with Citrix XenDesktop on IBM Flex System includes the following components:

- User access devices
 - Desktop PCs
 - Thin clients
 - Notebooks
 - Other handheld mobile devices
- Virtual infrastructure software
 - Citrix XenDesktop
- Hardware platform
 - IBM Flex System
 - IBM System Storage®
- Integration services
 - Assess and plan
 - Design
 - Implement
 - Operate and manage

Figure 2 shows the functional components of the SmartCloud Desktop Infrastructure solution.

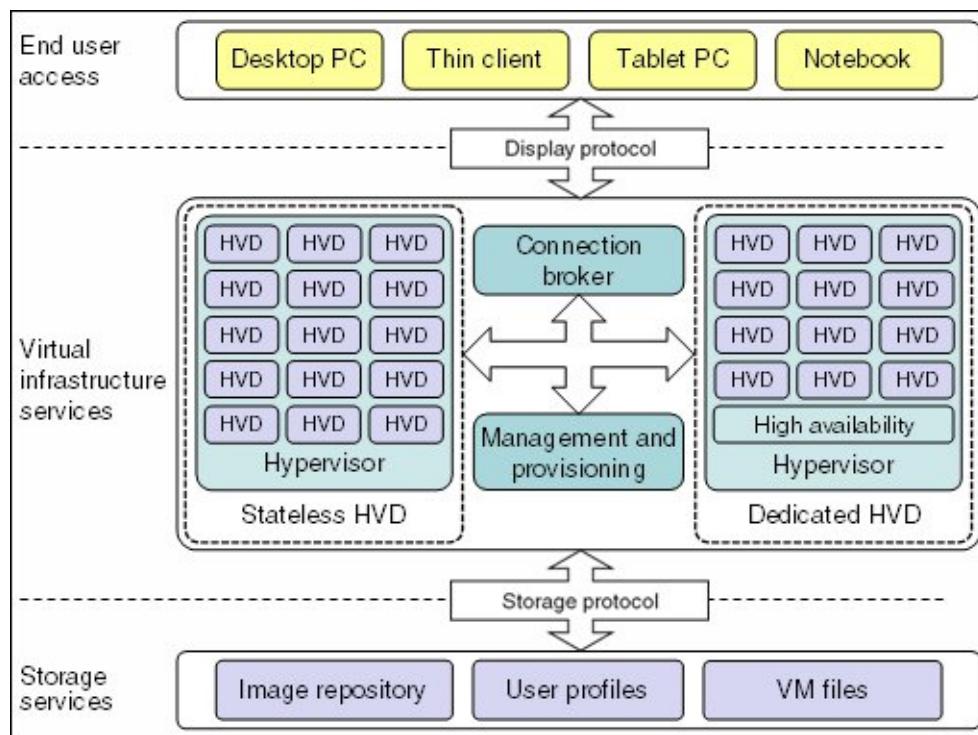


Figure 2. Functional components of the SmartCloud Desktop Infrastructure solution

The SmartCloud Desktop Infrastructure solution consists of three functional layers:

- **User access layer**
The user access layer is a user entry point into the virtual infrastructure. It includes traditional desktop PCs, thin clients, notebooks, and other handheld mobile devices.
- **Virtual infrastructure services layer**
The virtual infrastructure services layer provides the secure, compliant, and highly available desktop environment to the user. The user access layer interacts with the virtual infrastructure layer through display protocols. The choice of HDX, RDP, and ICA display protocols is available in Citrix XenDesktop.
- **Storage services layer**
The storage services layer stores user persona, profiles, gold master images, and actual virtual desktop images. The storage protocol is an interface between the virtual infrastructure services and storage services. The storage protocols include Network File System (NFS), Common Internet File System (CIFS), iSCSI, and Fibre Channel.

The virtual infrastructure services layer has the following key functional components:

- **Hypervisor**
The hypervisor provides a virtualized environment for running virtual machines (VMs) with the desktop operating systems in them. These VMs are called *hosted virtual desktops*.
- **Hosted virtual desktops**
An HVD is a VM that runs a user desktop operating system and applications.

- Connection broker

The connection broker is the point of contact for the client access devices that request the virtual desktops. The connection broker manages the authentication function and ensures that only valid users are allowed access to the infrastructure. When authenticated, it directs the clients to their assigned desktops. If the virtual desktop is unavailable, the connection broker works with the management and provisioning services to have the VM ready and available.

- Management and provisioning services

Management and provisioning services allow the centralized management of the virtual infrastructure, providing a single console to manage multiple tasks. These services provide image management, lifecycle management, and monitoring for hosted VMs.

- High availability services

High availability (HA) services ensure that the VM is up and running even if a critical software or hardware failure occurs. HA can be a part of connection broker functions for *stateless HVDs* or a separate failover service for *dedicated HVDs*.

A *dedicated* (or persistent) *HVD* is assigned permanently to the specific user (similar to a traditional desktop PC). Users log in to the same virtual desktop image every time they connect. All changes that they make and each application that they install are saved when the user logs off. The dedicated desktop model is best for users who need the ability to install more applications, store data locally, and retain the ability to work offline.

A *stateless* (*pooled* or *non-persistent*) *HVD* is allocated temporarily to the user. After the user logs off, changes to the image are discarded (reset). Then, the desktop becomes available for the next user, or a new desktop is created for the next user session. A persistent user experience (the ability to personalize the desktop and save data) is achieved through user profile management, folder redirection, and similar approaches. Specific individual applications can be provided to non-persistent desktops by using application virtualization technologies, if required.

Functional layers and components are supported by a hardware infrastructure platform that must provide the following features:

- Sufficient computing power to support demanding workloads
- Scalability to satisfy future growth requirements
- Reliability to support business continuity and 24x7 operations
- High-speed low-latency networking for better user experience
- Cost-efficient storage to handle large amounts of VM and user data
- Centralized management of combined physical and virtual infrastructure from a single user interface to simplify and automate deployment, maintenance, and support tasks

IBM Flex System is a future-proof, integrated platform that satisfies these requirements.

IBM Flex System platform

IBM Flex System is an integrated platform that delivers custom-tuned client-specific configurations for optimum flexibility. It combines compute nodes, networking, storage, and management into a complete data center building block that is built for future-proof, heterogeneous data centers with flexibility and open choice of architectures, hypervisors, and environments.

Figure 3 shows the IBM Flex System.



Figure 3. IBM Flex System

IBM Flex System offers unique capabilities that make this platform an exceptional choice for the deployment of the SmartCloud Desktop Infrastructure solution:

- Compute nodes

Compute nodes provide sufficient processing capacity for the most demanding SmartCloud Desktop Infrastructure deployments. IBM Flex System x240 is a dual-socket Intel Xeon processor E5-2600 product family-based compute node. It supports the most powerful 135 W Intel Xeon processor E5-2690, up to 768 GB of memory, and up to 16 physical I/O connections to provide scalable high-density HVD deployments.

- Networking

SmartCloud Desktop Infrastructure requires sufficient network bandwidth and efficient traffic management to host as many VMs as possible to ensure that all computing resources are not underused. IBM Flex System networking, when integrated into a chassis, can help to reduce communication latency and provide the required bandwidth with 10-Gb Ethernet LAN connectivity that has 40-Gb uplinks and 8-Gb or 16-Gb FC SAN connectivity. Virtual Fabric Adapters offer virtual network interface card (NIC) capability to allow up to 32 logical ports on a single compute node, with controllable bandwidth allocation to manage traffic prioritization. In addition, the integrated design simplifies the overall infrastructure to save costs and make scalability and management tasks easier.

- Management

IBM Flex System Manager™ is a systems management appliance that drives efficiency and cost savings in the data center. Flex System Manager provides a pre-integrated and virtualized management environment across servers, storage, and networking that is easily managed from a single interface. A single focus point for seamless multichassis management provides an instant and resource-oriented view of chassis and chassis resources for IBM System x® and IBM Power Systems™ compute nodes. You can reduce the number of interfaces, steps, and clicks it takes to manage IT resources. You can intelligently manage and deploy workloads based on resource availability and predefined policies. And you can manage events and alerts to increase system availability and reduce downtime in addition to reducing operational costs.

- Storage

As a virtualized storage system that provides block volumes and file volumes, IBM Storwize® V7000 Unified complements virtual desktop environments. The system offers robust enterprise-class storage capabilities, which include thin provisioning, automated tiering, internal and external virtualization, clustering, replication, multiprotocol support, and a next-generation graphical user interface (GUI). These features can be applied in virtual desktop environments in applications, for example, that optimize storage capacity and performance or that simplify desktop user profile management and backup. The Storwize V7000 Unified is flexible enough to support entry virtual desktop environments, but can also be scaled to support enterprise virtual desktop environments.

The N series systems provide powerful virtualization and thin provisioning capabilities to help you maximize storage utilization and minimize the use of power, cooling, and floor space. At the same time, you can improve staff productivity with an integrated suite of application-aware manageability software that offers policy-based automation to otherwise manual tasks, improving storage efficiency.

In summary, because of its integrated capabilities, IBM Flex System in a SmartCloud Desktop Infrastructure solution can help to achieve the following advantages:

- Better VM density due to large memory and I/O capacity support
- Lower communication latency due to integrated switching capabilities for a better user experience
- Simplified deployment and management of both physical and virtual infrastructures due to integrated design and IBM Flex System Manager capabilities

Solution architecture

IBM SmartCloud Desktop Infrastructure with Citrix XenDesktop can help to transform Microsoft Windows desktops, applications, and data into a cloud-type service that is accessible on virtually any device, anywhere. Citrix offers tailored solutions that range from the affordable, all-in-one Citrix VDI-in-a-Box for simple IT organizations to the enterprise-wide Citrix XenDesktop. XenDesktop is a comprehensive desktop virtualization solution for every user with multiple delivery models that are optimized for flexibility and cost efficiency. Both solution types deliver a rich, high-definition user experience across any network that uses Citrix HDX technologies.

By using the open architecture of Citrix XenDesktop, customers can adopt desktop virtualization quickly and easily with any hypervisor, storage, or management infrastructure.

The following XenDesktop features provide a familiar experience for the user:

- Multiple monitor support
- 3D graphics business application support
- Multimedia support
- Printing from a virtual desktop
- Accessing USB devices and other peripheral devices
- Roaming user profiles

XenDesktop offers several levels of security features, including the following features:

- Multifactor authentication
- Traffic encryption
- Built-in password management
- SSL tunneling to ensure that all connections are encrypted

The following Citrix XenDesktop features provide centralized administration and management:

- Microsoft Active Directory
- Web-based administrative console
- Automated desktop provisioning and storage optimization

XenDesktop includes the following scalability, integration, and optimization features:

- VMware vSphere, Microsoft Hyper-V, and XenServer hypervisor support
- Integration with VMware vCenter to achieve cost-effective densities, high levels of availability, and advanced resource allocation control for virtual desktops
- Automated provisioning of desktop images that share virtual disks with a master image

Figure 4 shows the components of the Citrix XenDesktop on IBM Flex System solution.

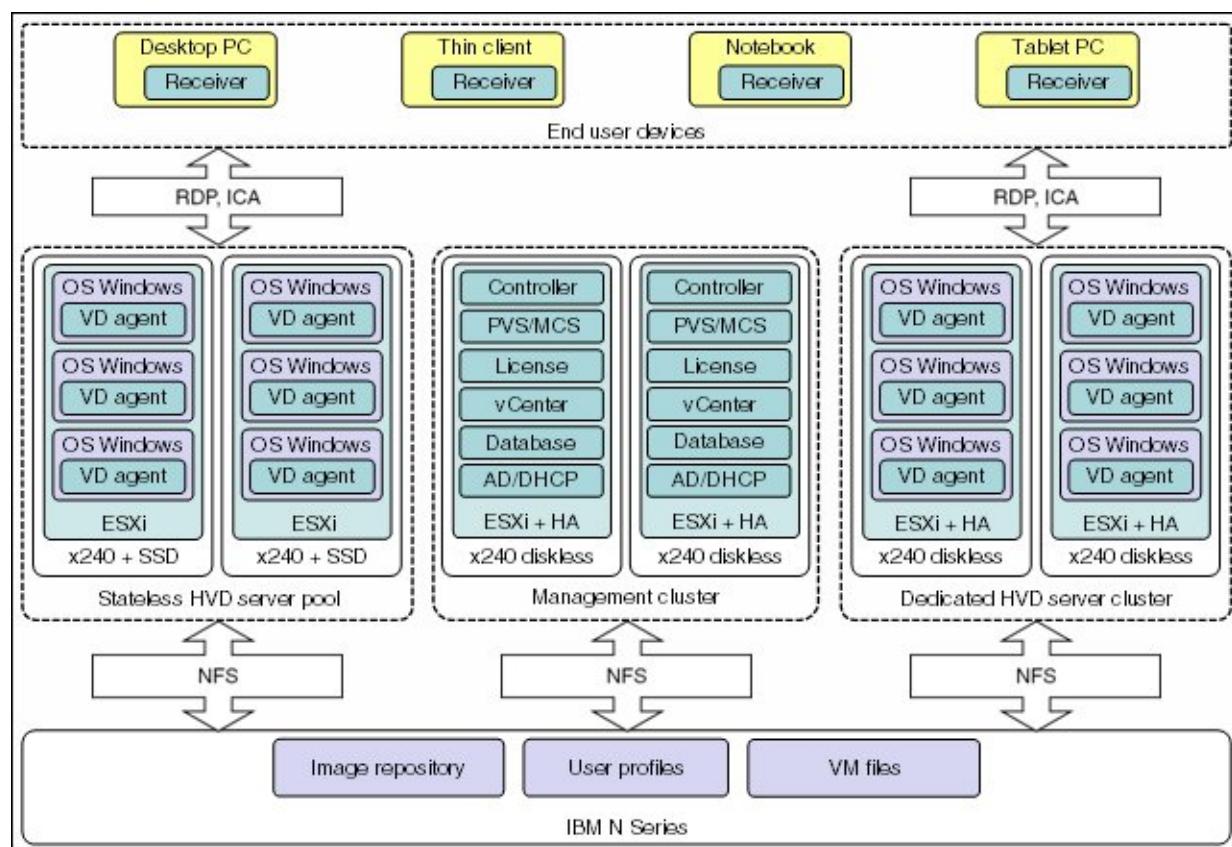


Figure 4. Components of the Citrix XenDesktop on IBM Flex System solution

The core hardware component of the solution is IBM Flex System with integrated x86 compute nodes, LAN switches and management appliance, and the external storage system:

- IBM Flex System x240 compute nodes

The x240 compute nodes contain an embedded VMware ESXi hypervisor to host VMs that are used for virtual desktops and for management and provisioning tasks. The x240 compute nodes are combined into three groups: stateless HVD pool, dedicated HVD cluster, and management cluster.

Stateless HVD pool nodes are configured with local SSD storage that hosts VM files. The nodes use NFS storage to get local VM images from the repository. High availability is provided by the connection broker (XenDesktop Controller). That is, if a VM or node failure occurs, the connection broker redirects the user to another available virtual desktop.

The nodes in a dedicated cluster are configured with no local storage. All VM files are placed onto an external NFS-based shared storage. High availability is provided by failing over the VM to another compute node with the VMware High Availability feature.

The nodes in management cluster host VMs are running controlling instances, such as connection broker, centralized management tools, and database for storing control information. These nodes are connected to external NFS storage, such as IBM System Storage N Series, that stores VM files. Also, VMware HA provides high availability for management VMs.

- LAN switches

IBM Flex System Fabric EN4093 10Gb Scalable Switch provides redundant, high-speed, low-latency 10 Gb Ethernet network and NFS storage connectivity for the compute nodes.

- IBM Flex System Manager

IBM Flex System Manager is a systems management appliance that drives efficiency and cost savings in the data center. Flex System Manager provides a pre-integrated and virtualized management environment across servers, storage, and networking that is easily managed from a single interface.

- IBM System Storage N series

IBM System Storage N series storage systems provide primary and auxiliary storage for midsized enterprises, consolidating all of their fragmented application-based storage and unstructured data into one single-code system. Easily managed and expandable, this platform can help IT generalists increase their effectiveness. These systems offer integrated data access, intelligent management software, and data protection capabilities.

The Citrix XenDesktop core services have the following software components:

- Citrix Receiver

Citrix Receiver is a client software for accessing virtual desktops by using the Independent Channel Architecture (ICA) protocol. The client software can run on different types of user access devices, including desktop PCs, notebooks, thin clients, and others.

- Citrix Virtual Desktop Agent

Citrix Virtual Desktop Agent is installed on virtual desktops and supports Citrix Receiver direct connections through the ICA.

- Citrix XenDesktop Controller

Citrix XenDesktop Controller is a software service that is responsible for connection brokering, authenticating users, and starting virtual desktops and user persona management if required. Authentication of users is performed through Windows Active Directory.

- Citrix Provisioning Services or Machine Creation Services
Citrix Provisioning Services and Machine Creation Services create and provision virtual desktops from desktop images. Provisioning Services support stateless HVD pools, and Machine Creation Services can support both stateless and dedicated HVD pools.
- Citrix License Server
Citrix License Server manages licenses for all XenDesktop components.
- Citrix Data Store
Citrix Data Store is a database that stores configuration information for the XenDesktop environment.
- VMware ESXi
VMware ESXi is hypervisor that is used to host VMs.
- VMware vCenter
The VMware vCenter service acts as a central administrator for VMware ESX/ESXi servers that are connected on a network. vCenter Server provides a central point for configuring, provisioning, and managing VMs in the data center.

Usage scenarios

In the healthcare industry, staff are constantly on the move, but need fast, security-rich access to patients' electronic medical records that are in compliance with data privacy regulations. By combining single sign-on capabilities with a virtual desktop infrastructure, healthcare staff can access multiple systems and applications to obtain medical records or images with a single, more secure sign-on.

In the education industry, a virtual desktop infrastructure can help schools to extend the lifecycle of existing PCs, in addition to allowing the schools to adopt new technology. Students can receive the same quality of education, regardless of the availability of hardware, device or location. At the same time, IT staff can reduce the time, cost, and complexity that are associated with maintenance, upgrades, provisioning, reimaging, and repairing the school's technology assets.

For the public sector, local, state, and federal agencies must extend support to an ever-increasing collection of personal devices and do so under stringent security measures. A virtual desktop can give personnel the anytime, anywhere access they need to maintain productivity. It can also provide the centralized security and control that are necessary to help maintain extreme data confidentiality. Agencies can also expedite provisioning and upgrades to multiple devices at a sustainable level of cost and effort.

Integration

IBM SmartCloud Desktop Infrastructure enables easy integration with optional security and endpoint management technologies, including the following technologies:

- IBM Security Access Manager for Enterprise Single Sign-On offers streamlined user access with automated sign-on and sign-off plus a single password for all applications. This technology can reduce help desk costs, improve productivity, and strengthen security for virtualized desktops.
- IBM Tivoli® Endpoint Manager combines endpoint and security management into a single solution. With this solution, your team can see and manage physical and virtual endpoints, such as servers, desktops, roaming notebooks, and specialized equipment such as point-of-sale devices, automated teller machines (ATMs), and self-service kiosks.

IBM SmartCloud Desktop Services

Transitioning to a virtualized environment from traditional desktops can be a time-consuming effort, often requiring specialized skills that are not readily available in-house. You must carefully manage implementations to support many users, applications, and complementary software to help provide the security and management functions that are necessary to succeed.

By using time-proven methods, proprietary tools, and extensive expertise that are developed through real-world client implementations, SmartCloud Desktop Services can accelerate your transition to a less complex, virtualized desktop environment. Robust services, which include assessment and planning, design and implementation, and operation and management, in addition to a phased delivery approach, help to speed your return on investment and reduce the risk of business disruption. Through these services, a broader range of users, from power users to disconnected users, can have faster, more security-rich access to resources, helping to improve their productivity and increasing business flexibility.

Figure 5 illustrates the services approach.



Figure 5. SmartCloud Desktop Services

Reference design

The Citrix XenDesktop on IBM Flex System solution has the following key building blocks:

- Compute nodes that support stateless and dedicated HVD pools
- Compute nodes cluster that runs management and provisioning tasks
- Integrated management appliance
- External shared storage system

Table 1 shows the building blocks of the Citrix XenDesktop on IBM Flex System solution that are used in small, medium, and large deployments, with a 50/50 split between stateless and dedicated HVDs. The actual number of users or virtual desktops per node depends on the user type and memory, CPU, and storage requirements for those VMs.

Table 1. Building blocks of the Citrix XenDesktop on IBM Flex System solution

Building block	Number of elements in a building block			Element type and configuration
	Small	Medium	Large	
Stateless HVD server pool (N+1 redundancy)	2	4	8	x240 compute node <ul style="list-style-type: none"> • 2x Intel Xeon processor E5-2680 • 256 GB memory • 2x 200 GB SATA SSDs • 4x 10 Gb Ethernet ports • 1x Embedded ESXi hypervisor
Dedicated HVD server pool (N+1 redundancy)	2	4	8	x240 compute node <ul style="list-style-type: none"> • 2x Intel Xeon processor E5-2680 • 256 GB memory • 4x 10 Gb Ethernet ports • 1x Embedded ESXi hypervisor
Management cluster (N+N redundancy)	2	2	2	x240 compute node <ul style="list-style-type: none"> • 2x Intel Xeon processor E5-2680 • 128 GB memory • 4x 10 Gb Ethernet ports • 1x Embedded ESXi hypervisor
Management appliance	1	1	1	IBM Flex System Manager
External shared storage	1	1	1	IBM System Storage N series

Figure 6 shows components of IBM Flex System that are used in the typical medium-sized reference design of the IBM SmartCloud Desktop Infrastructure solution, with 50/50 split between stateless and dedicated HVDs.

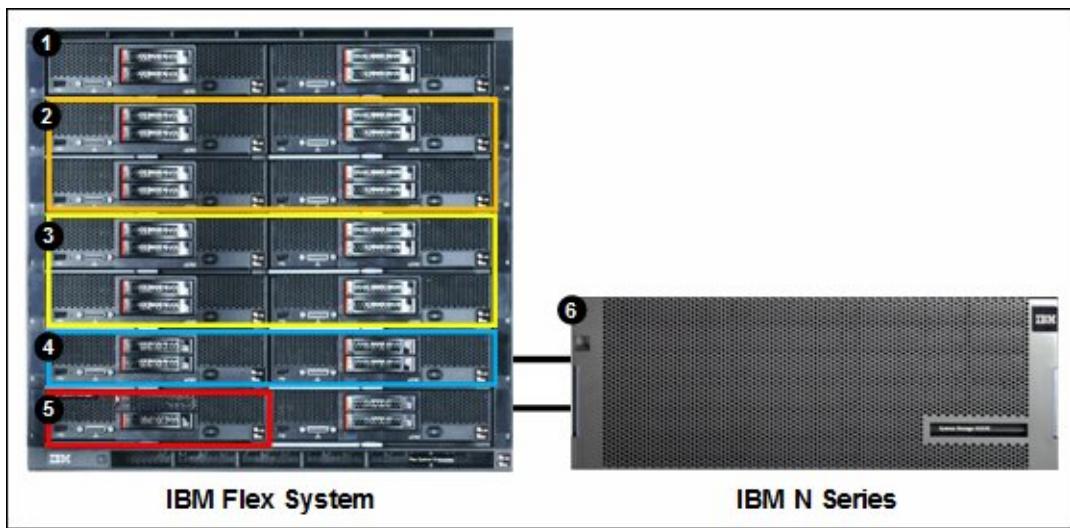


Figure 6. IBM Flex System SmartCloud Desktop Infrastructure solution reference configuration

Table 2 highlights the details of the reference configuration for the SmartCloud Desktop Infrastructure with IBM Flex System solution that is shown in Figure 6.

Table 2. Reference configuration of SmartCloud Desktop Infrastructure with IBM Flex System (Part 1)

Diagram reference	Description
1	1x Enterprise Chassis with installed infrastructure components 2x EN4093 10Gb Scalable switches with activated Upgrade 1 (28 internal ports, 12 external ports) and optical SW SFP+ transceivers (not shown in Figure 6) 2x Chassis Management Modules (not shown in Figure 6)
2	4x x240 compute nodes for stateless HVDs (N+1 redundancy) 2x Intel Xeon processor E5-2680 256 GB memory 2x 200 GB SATA SSDs 4x 10 Gb Ethernet ports on CN4054 Virtual Fabric Adapter 1x Embedded ESXi hypervisor on a USB key
3	4x x240 compute nodes for dedicated HVDs (N+1 redundancy) 2x Intel Xeon processor E5-2680 256 GB memory 4x 10 Gb Ethernet ports on CN4054 Virtual Fabric Adapter 1x Embedded ESXi hypervisor on a USB key

Table 2. Reference configuration of SmartCloud Desktop Infrastructure with IBM Flex System (Part 2)

Diagram reference	Description
4	2x x240 compute nodes for management cluster 2x Intel Xeon processor E5-2680 128 GB memory 4x 10 Gb Ethernet ports on CN4054 Virtual Fabric Adapter 1x Embedded ESXi hypervisor on a USB key
5	1x IBM Flex System Manager management appliance
6	1x IBM System Storage N Series external shared storage

Ordering information

Table 3 shows the part numbers and quantities for ordering the reference configuration in Figure 6.

Table 3. Ordering information for SmartCloud Desktop Infrastructure with IBM Flex System (Part 1)

Diagram reference	Description	Part number	Qty
1	Chassis with installed infrastructure components		
	IBM Flex System Enterprise Chassis with 2x2500W PSU, Rackable	8721A1x*	1
	IBM Flex System Enterprise Chassis 2500W Power Module	43W9049	4
	IBM Flex System Enterprise Chassis 80mm Fan Module Pair	43W9078	2
	IBM Flex System Chassis Management Module	68Y7030	1
	IBM Flex System Fabric EN4093 10Gb Scalable Switch	49Y4270	2
	IBM Flex System Fabric EN4093 10Gb Scalable Switch (Upgrade 1)	49Y4798	2
	IBM SFP+ SR Transceiver	46C3447	4
2	Compute nodes for stateless HVDs (N+1 redundancy)		
	IBM Flex System x240 Compute Node (Intel Xeon processor E5-2680)	8737M1x*	4
	Intel Xeon 8C Processor Model E5-2680 130W 2.7GHz/1600MHz/20MB	81Y5188	4
	16GB (1x16GB, 2Rx4, 1.5V) PC3-12800 CL11 ECC DDR3 1600MHz LP RDIMM	00D4968	64
	IBM 200GB SATA 2.5in MLC HS SSD	43W7718	8
	IBM Flex System x240 USB Enablement Kit	49Y8119	4
	IBM Flex System CN4054 10Gb Virtual Fabric Adapter	90Y3554	4
	IBM USB Memory Key for VMware ESXi 5.0 Update 1	41Y8307	4

Table 3. Ordering information for SmartCloud Desktop Infrastructure with IBM Flex System (Part 2)

Diagram reference	Description	Part number	Qty
3	Compute nodes for dedicated HVDs (N+1 redundancy)		
	IBM Flex System x240 Compute Node (Intel Xeon processor E5-2680)	8737M1x*	4
	Intel Xeon 8C Processor Model E5-2680 130W 2.7GHz/1600MHz/20MB	81Y5188	4
	16GB (1x16GB, 2Rx4, 1.5V) PC3-12800 CL11 ECC DDR3 1600MHz LP RDIMM	00D4968	64
	IBM Flex System x240 USB Enablement Kit	49Y8119	4
	IBM Flex System CN4054 10Gb Virtual Fabric Adapter	90Y3554	4
4	Compute nodes for management cluster		
	IBM Flex System x240 Compute Node (Intel Xeon processor E5-2680)	8737M1x*	2
	Intel Xeon 8C Processor Model E5-2680 130W 2.7GHz/1600MHz/20MB	81Y5188	2
	16GB (1x16GB, 2Rx4, 1.5V) PC3-12800 CL11 ECC DDR3 1600MHz LP RDIMM	00D4968	16
	IBM Flex System x240 USB Enablement Kit	49Y8119	2
	IBM Flex System CN4054 10Gb Virtual Fabric Adapter	90Y3554	2
5	Management appliance		
	IBM Flex System Manager Node with embedded 10Gb Virtual Fabric, Xeon 8C E5-2650 95W 2.0GHz/1600MHz/20MB, 8x4GB, 1TB HS 2.5in SATA, 2x200GB 1.8in SATA SSD	8731A1x*	1
	IBM Flex System Manager Per Managed Chassis with 3 Year SW S&S	90Y4222**	1
6	External shared storage		
	IBM System Storage N Series	Varies	1

* The x in the part number represents a country-specific letter. For example, the EMEA part number is 8731A1G, and the US part number is 8731A1U. Ask your local IBM representative for specific details.

** Part number 90Y4222 is used for ordering the Features on Demand entitlement license in the United States, Canada, Asia Pacific, and Japan. Part number 95Y1174 is used for ordering the Features on Demand entitlement license in Latin America and Europe/Middle East/Africa.

Related information

For more information, see the following documents:

- *IBM Flex System Manager Sales Manual*
http://www.ibm.com/common/ssi/rep_sm/1/897/ENUS5641-F01
- *IBM Flex System x240 Compute Node Sales Manual*
http://www.ibm.com/common/ssi/rep_sm/1/897/ENUS8737_h01
- *IBM Flex System Enterprise Chassis Sales Manual*
http://www.ibm.com/common/ssi/rep_sm/1/897/ENUS7893_h01
- *IBM Flex System Enterprise Chassis Product Guide*, TIPS0863
<http://www.redbooks.ibm.com/abstracts/tips0863.html>
- *IBM Flex System Fabric EN4093 10Gb Scalable Switch Product Guide*, TIPS0864
<http://www.redbooks.ibm.com/abstracts/tips0864.html>
- *IBM Flex System x240 Compute Node Product Guide*, TIPS0860
<http://www.redbooks.ibm.com/abstracts/tips0860.html>
- *IBM Flex System Manager Product Guide*, TIPS0862
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- *IBM Flex System Products and Technology*, SG24-7984
<http://www.redbooks.ibm.com/abstracts/sg247984.html>
- *Implementing Systems Management of IBM PureFlex System*, SG24-8060
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